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L1	989	703/14.ccls.	US-PGPUB; USPAT; EPO; DERWENT	OR	OFF	2006/05/20 16:41
L2	402	(model adj check\$3) and @ad<"20010113"	US-PGPUB; USPAT; EPO; DERWENT	OR	OFF	2006/05/20 17:14
L3	50	L2 and trace	US-PGPUB; USPAT; EPO; DERWENT	OR	OFF	2006/05/20 17:17
L4	20	L2 and disjoint	US-PGPUB; USPAT; EPO; DERWENT	OR	OFF	2006/05/20 17:18
L5	3	(disjoint adj trace\$1) and @ad<"20010113"	US-PGPUB; USPAT; EPO; DERWENT	OR	OFF	2006/05/20 17:21
L6	421	(multiple adj trace\$1) and @ad<"20010113"	US-PGPUB; USPAT; EPO; DERWENT	OR	OFF	2006/05/20 17:21

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L1	1	(mutually-disjoint or (mutually adj disjoint) and trace\$1 and model).clm.	US-PGPUB	OR	OFF	2006/05/20 18:03
L2	1	(mutually-disjoint or (mutually adj disjoint) and trace\$1).clm.	US-PGPUB	OR	OFF	2006/05/20 18:03
L3	5	(mutually-disjoint or (mutually adj disjoint)).clm.	US-PGPUB	OR	OFF	2006/05/20 18:03
L4	3	((reachable adj set\$1) and trace\$1 and intersection\$1).clm.	US-PGPUB	OR	OFF	2006/05/20 18:08
L5	3	(disjoint and intersection\$1 and trace\$1 and intersection\$1).clm.	US-PGPUB	OR	OFF	2006/05/20 18:08

EAST Search History

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L1	2	"6691078".pn.	US-PGPUB; USPAT; EPO; DERWENT	OR	OFF	2006/05/20 18:11
L2	136	(disjoint near path\$1) and @ad<"20010113"	US-PGPUB; USPAT; EPO; DERWENT	OR	OFF	2006/05/20 18:12

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Vicario, E.;
[Software Engineering, IEEE Transactions on](#)
Volume 27, Issue 8, Aug. 2001 Page(s):728 - 748
Digital Object Identifier 10.1109/32.940727

[AbstractPlus](#) | [References](#) | [Full Text: PDF\(1496 KB\)](#) | [IEEE JNL](#)
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» Key

IEEE JNL IEEE Journal or Magazine

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IEE JNL IEE Journal or Magazine

1. Handling obstacles in goal-oriented requirements engineering

van Lamsweerde, A.; Letier, E.;

[Software Engineering, IEEE Transactions on](#)

Volume 26, Issue 10, Oct. 2000 Page(s):978 - 1005

Digital Object Identifier 10.1109/32.879820

[AbstractPlus](#) | [References](#) | [Full Text: PDF\(976 KB\)](#) [IEEE JNL](#)
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IEEE CNF IEEE Conference Proceeding

2. Symbolic model checking for sequential circuit verification

Burch, J.R.; Clarke, E.M.; Long, D.E.; McMillan, K.L.; Dill, D.L.;

[Computer-Aided Design of Integrated Circuits and Systems, IEEE Transactions on](#)

Volume 13, Issue 4, April 1994 Page(s):401 - 424

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IEEE STD IEEE Standard

3. FunState—an internal design representation for codesign

Strehl, K.; Thiele, L.; Gries, M.; Ziegenbein, D.; Ernst, R.; Teich, J.;

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Volume 9, Issue 4, Aug. 2001 Page(s):524 - 544

Digital Object Identifier 10.1109/92.931229

[AbstractPlus](#) | [References](#) | [Full Text: PDF\(448 KB\)](#) [IEEE JNL](#)
[Rights and Permissions](#)**4. A logical characterization of bisimulation for labeled Markov processes**

Desharnais, J.; Edalat, A.; Panangaden, P.;

[Logic in Computer Science, 1998. Proceedings. Thirteenth Annual IEEE Symposium on](#)

21-24 June 1998 Page(s):478 - 487

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van Lamsweerde, A.; Darimont, R.; Letier, E.;

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Volume 24, Issue 11, Nov. 1998 Page(s):908 - 926

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[AbstractPlus](#) | [References](#) | [Full Text: PDF\(448 KB\)](#) [IEEE JNL](#)
[Rights and Permissions](#)**6. Mechanizing CSP trace theory in higher order logic**

Camilieri, A.J.;

[Software Engineering, IEEE Transactions on](#)

Volume 16, Issue 9, Sept. 1990 Page(s):993 - 1004

- 7. Supervisory control of a rapid thermal multiprocessor**
Balemi, S.; Hoffmann, G.J.; Gyugyi, P.; Wong-Toi, H.; Franklin, G.F.;
[Automatic Control, IEEE Transactions on](#)
Volume 38, Issue 7, July 1993 Page(s):1040 - 1059
Digital Object Identifier 10.1109/9.231459
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- 8. Where do operations come from? A multiparadigm specification technique**
Zave, P.; Jackson, M.;
[Software Engineering, IEEE Transactions on](#)
Volume 22, Issue 7, July 1996 Page(s):508 - 528
Digital Object Identifier 10.1109/32.538607
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- 9. Logics for hybrid systems**
Davoren, J.M.; Nerode, A.;
[Proceedings of the IEEE](#)
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Jan 3-6 2001 Page(s):10 pp.
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[High-Assurance Systems Engineering Symposium, 1998. Proceedings. Third IEEE International](#)
13-14 Nov. 1998 Page(s):166 - 175
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- 12. Strand spaces: why is a security protocol correct?**
Fabrega, F.J.T.; Herzog, J.C.; Guttman, J.D.;
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- 13. Early experience with the Visual Programmer's WorkBench**
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- 14. Analysis of real-time rule-based systems with behavioral constraint assertions specified in Estella**
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[Selected Areas in Communications, IEEE Journal on](#)
Volume 12, Issue 1, Jan. 1994 Page(s):23 - 32
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Corbett, J.C.;
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- 17. Principles and methods of testing finite state machines-a survey**
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Volume 84, Issue 8, Aug. 1996 Page(s):1090 - 1123
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- 18. Completeness and consistency in hierarchical state-based requirements**
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- 19. Automatic symbolic verification of embedded systems**
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- 24. Modeling and formal verification of the Fairisle ATM switch fabric using MDGs**
Tahar, S.; Xiaoyu Song; Cerny, E.; Zijian Zhou; Langevin, M.; Ait-Mohamed, O.;
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- 25. Hierarchical finite state machines with multiple concurrency models**
Girault, A.; Bilung Lee; Lee, E.A.;
[Computer-Aided Design of Integrated Circuits and Systems, IEEE Transactions on](#)
Volume 18, Issue 6, June 1999 Page(s):742 - 760
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Relevance scale

1 A practical method for verifying event-driven software

Gerard J. Holzmann, Margaret H. Smith

May 1999 **Proceedings of the 21st international conference on Software engineering**

Publisher: IEEE Computer Society Press

Full text available: [pdf\(1.40 MB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

Keywords: case studies, feature interactive, formal methods, model checking, reactive systems, software testing, software verification, telephone call processing

2 Using model checking to generate tests from requirements specifications

Angelo Gargantini, Constance Heitmeyer

 October 1999 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 7th European software engineering conference held jointly with the 7th ACM SIGSOFT international symposium on Foundations of software engineering ESEC/FSE-7**, Volume 24 Issue 6

Publisher: Springer-Verlag, ACM Press

Full text available: [pdf\(1.44 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Recently, many formal methods, such as the SCR (Software Cost Reduction) requirements method, have been proposed for improving the quality of software specifications. Although improved specifications are valuable, the ultimate objective of software development is to produce software that satisfies its requirements. To evaluate the correctness of a software implementation, one can apply black-box testing to determine whether the implementation, given a sequence of system inputs, produces the ...

3 Bandera: extracting finite-state models from Java source code

James C. Corbett, Matthew B. Dwyer, John Hatcliff, Shawn Laubach, Corina S. Păsăreanu, Robby, Hongjun Zheng

June 2000 **Proceedings of the 22nd international conference on Software engineering**

Publisher: ACM Press

Full text available: [pdf\(345.15 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Finite-state verification techniques, such as model checking, have shown promise as a cost-effective means for finding defects in hardware designs. To date, the application of these techniques to software has been hindered by several obstacles. Chief among these is the problem of constructing a finite-state model that approximates the executable behavior of the software system of interest. Current best-practice involves hand-construction of models which is expensive (prohibitive for all but ...

Keywords: abstract interpretation, model checking, model extraction, program specialization, program verification, slicing

4 Three approximation techniques for ASTRAL symbolic model checking of infinite state real-time systems

Zhe Dang, Richard A. Kemmerer

June 2000 **Proceedings of the 22nd international conference on Software engineering**

Publisher: ACM Press

Full text available: [pdf\(359.05 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

ASTRAL is a high-level formal specification language for real-time systems. It has structuring mechanisms that allow one to build modularized specifications of complex real-time systems with layering. Based upon the ASTRAL symbolic model checker reported in [13], three approximation techniques to speed-up the model checking process for use in debugging a specification are presented. The techniques are random walk, partial image and dynamic environment generation. Ten mutation tests on a rai ...

Keywords: ASTRAL, formal methods, formal specification and verification, model checking, real-time systems, state machines, timing requirements

5 HSIS: a BDD-based environment for formal verification

Z. Aziz, F. Balarin, S.-T. Cheng, R. Hojati, T. Kam, S. C. Krishnan, R. K. Ranjan, T. R. Shiple, V. Singhal, S. Tasiran, H.-Y. Wang, R. K. Brayton, A. L. Sangiovanni-Vincentelli

June 1994 **Proceedings of the 31st annual conference on Design automation**

Publisher: ACM Press

Full text available: [pdf\(91.11 KB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

6 Verification of time partitioning in the DEOS scheduler kernel

John Penix, Willem Visser, Eric Engstrom, Aaron Larson, Nicholas Weininger

June 2000 **Proceedings of the 22nd international conference on Software engineering**

Publisher: ACM Press

Full text available: [pdf\(111.58 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper describes an experiment to use the Spin model checking system to support automated verification of time partitioning in the Honeywell DEOS real-time scheduling kernel. The goal of the experiment was to investigate whether model checking could be used to find a subtle implementation error that was originally discovered and fixed during the standard formal review process. To conduct the experiment, a core slice of the DEOS scheduling kernel was first translated without abstraction ...

7 Decoupling synchronization from local control for efficient symbolic model checking of statecharts

William Chan, Richard J. Anderson, Paul Beame, David H. Jones, David Notkin, William E. Warner

May 1999 **Proceedings of the 21st international conference on Software engineering**

Publisher: IEEE Computer Society Press

Full text available: [pdf\(1.31 MB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

Keywords: binary decision diagrams, fault tolerance, formal methods, formal verification, software specification, statecharts, symbolic model checking

8 Fault origin adjudication

 Karthikeyan Bhargavan, Carl A. Gunter, Davor Obradovic
August 2000 **Proceedings of the third workshop on Formal methods in software practice**

Publisher: ACM Press

Full text available:  [pdf\(522.20 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

When a program P fails to satisfy a requirement R supposedly ensured by a detailed specification S that was used to implement P, there is a question about whether the problem arises in S or in P. We call this determination fault origin adjudication and illustrate its significance in various software engineering contexts. The primary contribution of this paper is a fra ...

9 Formal verification of FIRE: a case study

 Jae-Young Jang, Shaz Qadeer, Matt Kaufmann, Carl Pixley
June 1997 **Proceedings of the 34th annual conference on Design automation DAC '97**

Publisher: ACM Press

Full text available:  [pdf\(93.19 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)
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We present our experiences with the formal verification of an automotivechip used to control the safety features in a car. We useda BDD based model checker in our work. We describe our verificationmethodology for verifying a very complicated property on arelatively large design. We also describe the bugs that were foundand present our views on how to make model checking an effectiveintegrated part of the design flow for complex hardware systems.

10 Using the ASTRAL model checker to analyze mobile IP

Zhe Dang, Richard A. Kemmerer
May 1999 **Proceedings of the 21st international conference on Software engineering**

Publisher: IEEE Computer Society Press

Full text available:  [pdf\(1.16 MB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

Keywords: ASTRAL, Encryption protocols, formal methods, formal specification and verification, real-time systems, state machines, timing requirements

11 Forward model checking techniques oriented to buggy designs

Hiroaki Iwashita, Tsuneo Nakata
November 1997 **Proceedings of the 1997 IEEE/ACM international conference on Computer-aided design**

Publisher: IEEE Computer Society

Full text available:  [pdf\(91.22 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)
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Forward model checking is an efficient symbolic model checking method for verifying realistic properties of sequential circuits and protocols. In this paper, we present the techniques that modify the order of state traversal on forward model checking, and that dramatically improve average CPU time for finding design errors. A failing property has to be checked again and again to analyze the bug until it is corrected. The techniques, therefore, can have significant impacts on actual verification ...

Keywords: formal verification, symbolic state traversal, symbolic model checking, forward model checking

12 Alcoa: the alloy constraint analyzer

 Daniel Jackson, Ian Schechter, Hya Shlyahter
June 2000 **Proceedings of the 22nd international conference on Software**

Alcoa is a tool for analyzing object models. It has a range of uses. At one end, it can act as a support tool for object model diagrams, checking for consistency of multiplicities and generating sample snapshots. At the other end, it embodies a lightweight formal method in which subtle properties of behaviour can be investigated. Alcoa's input language, Alloy, is a new notation based on Z. Its development was motivated by the need for a notation that is more closely tailored to ob ...

Keywords: constraint satisfaction, formal specifications, model checking, object models, relational logic, software analysis

13 Fitting formal methods into the design cycle

 **K. L. McMillan****June 1994 Proceedings of the 31st annual conference on Design automation****Publisher:** ACM PressFull text available:  [pdf\(325.61 KB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

14 A formal basis for architectural connection

 **Robert Allen, David Garlan****July 1997 ACM Transactions on Software Engineering and Methodology (TOSEM),**

Volume 6 Issue 3

Publisher: ACM PressFull text available:  [pdf\(463.23 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

As software systems become more complex, the overall system structure—or software architecture—becomes a central design problem. An important step toward an engineering discipline of software is a formal basis for describing and analyzing these designs. In the article we present a formal approach to one aspect of architectural design: the interactions among components. The key idea is to define architectural connectors as explicit semantic entities. These are specified as a col ...

Keywords: WRIGHT, formal models, model-checking, module interconnection, software analysis

15 Speeding up symbolic model checking by accelerating dynamic variable reordering

 **Christoph Meinel, Christian Stangier****March 2000 Proceedings of the 10th Great Lakes symposium on VLSI****Publisher:** ACM PressFull text available:  [pdf\(500.80 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Symbolic Model checking is a widely used technique in sequential verification. As the size of the OBDDs and also the computation time depends on the order of the input variables, the verification may only succeed if a well suited variable order is chosen. Since the characteristics of the represented functions are changing, the variable order has to be adapted dynamically. Unfortunately, dynamic reordering strategies are often very time consuming and sometimes do not provide any improvement of ...

16 Safety critical systems based on formal models

 **Lars Asplund, Kristina Lundqvist****December 2000 ACM SIGAda Ada Letters, Volume XX Issue 4****Publisher:** ACM PressFull text available:  [pdf\(732.05 KB\)](#) Additional Information: [full citation](#), [abstract](#), [index terms](#)

The Ravenscar profile for high integrity systems using Ada 95 is well defined in all real-

time aspects. The complexity of the run-time system has been reduced to allow full utilization of formal methods for applications using the Ravenscar profile. In the Mana project a tool set is being developed including a formal model of a Ravenscar compliant run-time system, a gnat compatible run-time system, and an ASIS based tool to allow for the verification of a system including both COTS and code that ...

17 Verification techniques for cache coherence protocols

 Fong Pong, Michel Dubois
March 1997 **ACM Computing Surveys (CSUR)**, Volume 29 Issue 1

Publisher: ACM Press

Full text available:  [pdf\(1.25 MB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

In this article we present a comprehensive survey of various approaches for the verification of cache coherence protocols based on state enumeration, (symbolic model checking, and symbolic state models. Since these techniques search the state space of the protocol exhaustively, the amount of memory required to manipulate that state information and the verification time grow very fast with the number of processors and the complexity of the protocol mechanism ...

Keywords: cache coherence, finite state machine, protocol verification, shared-memory multiprocessors, state representation and expansion

18 Efficient generation of counterexamples and witnesses in symbolic model checking

 E. M. Clarke, O. Grumberg, K. L. McMillan, X. Zhao
January 1995 **Proceedings of the 32nd ACM/IEEE conference on Design automation**

Publisher: ACM Press

Full text available:  [pdf\(225.22 KB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

19 Strategic directions in real-time and embedded systems

 John A. Stankovic
December 1996 **ACM Computing Surveys (CSUR)**, Volume 28 Issue 4

Publisher: ACM Press

Full text available:  [pdf\(209.23 KB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

20 Formal specification and verification of a dataflow processor array

Thomas A. Henzinger, Xiaojun Liu, Shaz Qadeer, Sriram K. Rajamani
November 1999 **Proceedings of the 1999 IEEE/ACM international conference on Computer-aided design**

Publisher: IEEE Press

Full text available:  [pdf\(98.54 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We describe the formal specification and verification of the VGI parallel DSP chip [1], which contains 64 compute processors with ~30K gates in each processor. Our effort coincided in time with the "informal" verification stage of the chip. By interacting with the designers, we produced an abstract but executable specification of the design which embodies the programmer's view of the system. Given the size of the design, an automatic check that even one of the 64 processors sati ...

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NUSMV: a new symbolic model checker - group of 12 »

AJ Cimatti, EJ Clarke, FJ Giunchiglia, MJ Roveri - International Journal on Software Tools for Technology ..., 2000 - Springer

... N U SMV: a new symbolic **model checker** ... NuSMV is the result of the reengineering and reimplementation of the CMU SMV [26,47] symbolic **model checker**. ...

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[ps] Automated software testing using model-checking - group of 3 »

J Callahan, F Schneider, S Easterbrook - Proceedings 1996 SPIN Workshop, 1996 - cis.upenn.edu

... While the partitions created by a CCC are **disjoint** ... specific tests into one or more partitions using a **model checker**. We can determine if a **trace** belongs to a ...

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... Verification of a Behavioural Subset of UML Statechart Diagrams Using the SPIN Model-checker - group of 6 »

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... as the work constitutes a basis for a PROMELA/SPIN based **model-checker** for UML ... where F is a finite set of sequential automata with mutually **disjoint** sets of ...

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... i (where S_i is the set of states of A_i) are pairwise **disjoint**. words accepted by AG (all states of AG considered accepting). We define the **trace** behavior of ...

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[ps] Is your model checker on time - group of 7 »

L Aceto, F Laroussinie - Proc. 24th Int. Symp. Math. Found. Comp. Sci.(MFCS'99), ..., 1999 - lsv.ens-cachan.fr

... Is your **Model Checker** on Time? ... The complexity of implementation verification for (concurrent) programs is studied in, eg, [39,56,63], where both **trace**- and tree ...

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P Ammann, W Ding, D Xu - International Conference on Engineering of Complex Computer ..., 2001 - doi.ieeecs.org

... 0 , some dangerous xy -**trace** is a prefix of a **trace** that leads ... 3 **MODEL CHECKER**

IMPLEMENTATION ... change the semantics, that is, $p_1 \dots p_m$ are **disjoint** (if the ...

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R Nalumasu, G Gopalakrishnan - Fourth NASA Langley Formal Methods Workshop, 1997 - techreports.larc.nasa.gov

Page 1. PV: A **Model-Checker** for Verifying LTL-X Properties Ratan Nalumasu Ganesh

Gopalakrishnan ... that the domains of i_1 and i_2 are **disjoint** and that ...

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... Designing a LTL **Model-Checker** Based on Unfolding Graphs ... We call **trace** function Φ

AP the mapping in $S \rightarrow [AP]$... Post is a P/T net (P and T are **disjoint** sets of ...

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... generation mechanism found in most **model checker** tools. ... into a complete cover of

disjoint equivalence partitions on ... If an inconsistency between a **trace** and the ...

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L de Alfaro, R Alur, R Grosu, T Henzinger, M Kang, ... - University of California at Berkeley Department of ..., 2000 - www-cad.eecs.berkeley.edu

... The symbolic **model checker** is based on BDD engines ... Implementation verification by checking **trace** containment between ... modules, if they have **disjoint** sets of ...

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... expressing liveness properties since liveness is expressed by means of transition information.) For this purpose we introduce two **mutually** recursively defined ...Cited by 27 - [View as HTML](#) - [Web Search](#)Model Checking Complete Requirements Specifications Using Abstraction - group of 10 »

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... criterion: for each state and each trigger event, the guard conditions must be **mutually disjoint**. ... We use the **model checker** SPIN [10] as external tool to decide ...Cited by 13 - [Web Search](#) - [BL Direct](#)An Outline of PVS Semantics for UML Statecharts - group of 2 »

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... in terms of cases, it is natural require that the cases are **mutually disjoint**. ... were close to the maximum size which could be evaluated with a **model checker** ...Cited by 3 - [Web Search](#) - [BL Direct](#)Applying the SCR Requirements Method to a Simple Autopilot - group of 9 »

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... Section 4 describes how the algorithms are used with the **model checker** VIS

[3 ... k and $[k, k]$ as = k. – CD is a collection of **mutually disjoint** sets of ...

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